SEALS

SEA LIONS, WALRUSES

N EASTERN NORTH PACIFIC AND ARCTIC WATERS

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SEALS

SEA LIONS, WALRUSES

IN EASTERN NORTH PACIFIC AND ARCTIC WATERS

Compiled by Alice Seed
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CONTENTS

INTRODUCTION
Alice Seed 2

NORTHERN FUR SEAL — STELLER'S SEA BEAR
Clifford H. Fiscus 5

CALIFORNIA SEA LION
Bruce R. Mate 12

STELLER SEA LION
Roger L. Gentry 18

HARBOR SEAL
Terrell C. Newby 25

ELEPHANT SEAL
Terrell C. Newby 30

PACIFIC WALRUS
Karl W. Kenyon 32

BIBLIOGRAPHY 39

CONTRIBUTORS 40

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INTRODUCTION

Alice Seed

Seals are aquatic animals, living mostly in the marine environment, although several species belonging to the group commonly known as hair seals inhabit freshwater lakes. The seals, sea lions, and walruses belong to the order of animals called Pinnipedia, meaning feather-footed, whose limbs are modified for swimming. Among the mammals, their closest relatives are the carnivores, one of which, the sea otter, has also adapted to an aquatic environment. Some members of the group are found near the shore in relatively shallow waters; others may move off hundreds of miles from the nearest land; some are rather sedentary, spending their lives within a few miles of their birthplaces; others may range hundreds or even thousands of miles in annual migrations. No matter how far these animals roam at sea, they all must return to land or ice to give birth to their young.

Of names given to seals, a large group may be called a herd and land occupied by a breeding colony is called a rookery. Adult males, or bulls, may gather harems of females, or cows. The newborn seal or sea lion is a pup, until it is a year old and then it is a yearling, a baby walrus is a calf. Groups of seals are sometimes called pods, and immature males are bachelors. Some of the early explorers and seamen related members of the group to land mammals. Thus you find names like sea-dogs, sea-cats, sea-bears, sea-lion, and sea-wolves in the early literature.

Many seals or sea lions are sociable, gathering in large aggregations. Pinnipeds seldom venture far from the water when on land or ice. Different species favor different types of terrain ranging from rocky, boulder-strewn beaches and ragged cliffs to smooth, sandy beaches and both fast and floe ice. All species share one requirement — the land or ice must be relatively iso-

lated and free from regular human intrusion.

The pinniped body has evolved primarily in response to a cold environment. It is streamlined — a shape determined by its need for swift and efficient swimming. The body is enveloped in thick subcutaneous fat, commonly called blubber, which provides thermal insulation, buoyancy, and reserve energy during long fasts and lactation.

The three families, Otariidae, Odobenidae, and Phocidae of the order Pinnipedia are represented in this collection of articles about seals found in the eastern North Pacific and arctic waters. The Otariidae — eared seals (sea lions and fur seals), — have obvious, small, external ears, whereas the Odobenidae — walruses and the Phocidae — earless or true seals — have no external ears. The Otariids and Phocids have very short tails that are not used for swimming, and in the walrus the tail is almost vestigial.

The long bones of the forelimb are greatly reduced and most of the forelimb is retained within the body. The principal external differences between the families are in their methods of locomotion. The Otariids have hind flippers that can be turned forwards under the body, and then used in a four-footed movement on land. All the flippers have bare, black palms and soles. In water the front flippers propel them; on land they support the body. When moving on land the front flippers are used alternately, or together if moving fast, and the hind flippers are brought up together. Hind flippers are not used much in swimming, but act as a rudder.

The flippers of the walrus are like those of the Otariids in most respects, although the fore flipper is smaller. While swimming, the hind end of the body moves laterally as in the Phocids, but the fore flippers are also used in a paddling motion.

The Phocids have hind flippers that cannot be turned forward, and are not used on land. All the flippers are furred. In this family, propulsion is by lateral movements of the lower body and the hind flippers. On land the chief method of moving is by wriggling along, hardly using the flippers. How much the fore flippers are used on land varies considerably among species.

Seals have whiskers and a normal mammalian hairy covering. The beautiful coats of the fur seals distinguish them from all other members of the order. The greater the number of hairs the thicker and softer the underfur, which is what makes the fur seals commercially valuable. The color of the pelage varies among species, and molting takes place in most species after breeding season.

Pinnipeds diet is entirely flesh and varies somewhat according to the species. Their jaws and teeth are developed to grasp and tear their food rather than chew it. They have fewer but more uniform teeth, as compared to most Carnivora.

All pinnipeds give birth on land or ice, and nurse their young for a month to over a year depending on the species. Delayed implantation is probably the rule in all pinnipeds with the possible exception of the walrus. The gestation period, eight to 12 months, is long in relation to similar sized animals. The newborn pup is precocious, able to move on land and to swim shortly after birth. Young seals spend considerable time playing, while developing adult habits.

Seals can see clearly both in water and on land. Their eyes are large, to spot their rather small prey. But it is quite possible that hearing is the most important sense. Some species are known to use echo-location to hunt prey.

The progenitors of the pinnipeds are unknown. Although it is probable their ancestors were entirely terrestrial, no connecting link has been found. The oldest known pinniped remains are from the Miocene. Two main groups are recognizable — the walking ones with their swimming mechanism near the forebody, and the crawling ones with their swimming mechanism near the hind body. Hence, some zoologists believe that the family tree had two trunks instead of one.

Even though man has expanded his knowledge of life in the sea during this century, he still does not understand an animal without studying it in relation to its total environment. Seals living as they do at the waters edge and in the water, mostly in remote or isolated areas, are difficult to study. The simple task of moving men and equipment to a study area becomes a major operation. Those seals that survive in populated areas are usually extremely wary and difficult to approach for study.

The editor wishes to thank those who have so generously contributed articles, several of which appeared in *Pacific Search,* photographs, and art work that have made this booklet possible.

NORTHERN FUR SEAL — STELLER'S SEA BEAR

Clifford H. Fiscus

The most truly oceanic of the North Pacific seals, the northern fur seal, *Callorhinus ursinus,* ranges across the subarctic waters of the North Pacific Ocean, Bering and Okhotsk Seas, and into the Sea of Japan. It rarely comes ashore except on its home islands during the breeding season from May through October. This mammal was first described by Georg Wilhelm Steller, German naturalist, during Bering's voyage in 1741 and named sea bear *(Ursus marinus).*

The northern fur seal belongs to the family Otariidae (the eared seals) and is the only member of its genus *Callorhinus.* Originally, seals that bred on the Pribilof Islands, Commander Islands, and Robben and several of the Kuril Islands were believed to be three distinct species. In recent years, however, seals marked with tags as pups on their islands of birth have been observed to intermingle on the breeding grounds and at sea in the eastern and western North Pacific Ocean. For this reason and because taxonomists cannot distinguish one from another, all northern fur seals are now considered one species.

Probably the most distinctive features of the fur seal are its thick waterproof underfur of over 300,000 hairs per square inch of skin and its unusually large flippers which are, relative to body size, almost twice the size of those of its relatives, the California and northern sea lions. The flippers of a northern fur seal have a thermoregulatory role of maintaining an even body temperature of the animal; its dense fur very effectively insulates other parts of the body and prevents loss of heat. The eyes of this mammal are large and its night vision apparently good; its ears are tightly rolled cylinders with a waxy orifice which prevents the entrance of water; and its nostrils close when it dives. At sea, fur seals appear black under most light conditions;

when approached, the often rear out of the water exposing light-colored or gray throats. On land, rookery filth stains the pelage of the fur seal yellowish-brown.

An adult female weighs 100 - 140 pounds and an adult male weighs from 400 - 600 pounds. Newborn pups weigh 10 - 12 pounds. The maximum life span of a fur seal probably does not exceed 30 years. A few seals marked with tags as pups have been recovered at 21 years old. Counts of growth rings in their canine teeth indicate ages up to 26 years for females and up to 17 years for males.

The northern fur seal population is estimated at 1.6 million. About 1.2 million are associated with the Pribilof Islands in the eastern Bering Sea, and the remaining 400,000 with the Commander Islands in the western Bering Sea or Robben Island in the Okhotsk Sea. Fur seals are again breeding on some of the Kuril Islands from which they were believed eliminated in the late 19th century; they have established a small and growing colony on San Miguel Island off the coast of southern California.

As mentioned earlier, fur seals range across the subarctic waters of the North Pacific Ocean. In the east, they are found south to about the latitude of the California-Mexico boundary, and in the west, south to about the latitude of Tokyo, Japan. Offshore, scattered seals are found in subarctic water, which extends south to about 42 degrees N (California-Oregon State line), although it shifts northward seasonally.

At sea, the fur seal tends toward solitude, although pairs

Characteristic resting posture of the northern fur seal at sea — on its back with three of its flippers and nose above the surface.

Photo by Karl W. Kenyon

and groups of three are fairly common. The largest group seen in 15 years of ocean research numbered about 100 animals. They were feeding on a large school of anchovies. Fur seal density in a given area is extremely variable, ranging from none to over 70 per square mile. One day in March of 1972, 169 seals were seen from a vessel during a 12-hour cruise off Grays Harbor, Washington. During 12 other days that month, the number of seals sighted ranged from zero to 44. Scientists of the Marine Mammal Division of the Northwest Fisheries Center, National Marine Fisheries Service, ran transects off California in 1965 and 1966, and off Washington in 1967. They seldom saw fur seals within 10 or 15 miles of shore. The animals were most numerous along the continental slope and in areas where the bottom topography causes upwellings of nutrient rich water and an abundance of prey species.

Since the behavior at sea (distribution and migration) and other characteristics of each subpopulation of fur seals are similar, a description of the fur seals in the eastern Bering Sea and North Pacific Ocean applies to all fur seals.

The maximum number of fur seals on the Pribilof Islands are there from July through September. Among the females, the older pregnant animals arrive first, from mid-June on. As the season progresses, younger pregnant and nonpregnant animals of all ages haul out on land. The peak of the pupping season occurs in early July. By early August the nursing females have fanned out on feeding forays to about 100 miles, and in some directions as far as 260 miles, returning at regular intervals to nurse their pups.

The female fur seal has a bicornuate or double uterus, which permits her to breed soon after parturition. The new pregnancy will occupy the uterine horn that lay dormant during the past year. Within a few hours or days after her arrival on the rookery, she will give birth to her pup, come into heat, and be bred by the bull to whose territory she was attracted when she came onto the rookery. The ovary associated with the dormant uterine horn will release an egg about the time the female is bred. After its union with the male sperm, the egg develops to the blastula (64 cell) stage, floats in the uterine horn as a "blastocyst" until late October or November, then implants (adheres) to the uterine wall and resumes growth. Most females mature sexually at age four or five years, and over 80 percent of those of age seven to 16 are pregnant each year. Extremes in age, of three and 23 years,

have been observed among pregnant females. Twins are rare. Of three twin births on record, only one of each pair survived to weaning age (about four months). Males and females are born in nearly equal numbers.

As with females, the males arrive in descending order of age, the older animals first. Most of the harem males, many who have been on the rookeries since early May, abandon their territories by mid-August, when some are sighted in the vicinity of the eastern Aleutian Islands. Younger males, mostly from three to five years old, begin to haul out on areas (hauling grounds) adjacent to the rookeries in late June, and continue to arrive through July and into September. Most of the new males appearing on land in August and September are two-year-olds. A few yearlings arrive in late September and October. Most remain at sea, however, and do not return to their island of birth until they are two years old. Some of the older seals may also remain at sea throughout the year.

Some seals of all ages and both sexes leave the islands in October, and the peak of the departure for most seals occurs in early November. Perhaps only a hundred or so (usually adult males) of the multitudes found on the Pribilof Islands in summer can still be seen there by December.

So far as is known, most of the adult males winter in the North Pacific Ocean south of the Aleutian Islands, although a few probably remain in the Bering Sea throughout the winter. Some may winter in the extreme North Pacific Ocean (Gulf of Alaska), and a very few migrate south with the females and younger males.

By the time the pups leave the islands in early November, they have molted their black birthcoats in exchange for ones of silvery gray, and have become competent swimmers from their many hours in the water since late August. They begin their migration alone, as do the other seals, appearing in the eastern Aleutian Islands passes from mid-November to early December. During some years, severe westerly storms may drive a few pups southeastward into Bristol Bay.

Females and young males begin to appear along the continental slope and shelf from Sitka, in southeast Alaska, to Washington in late November, and as far south as San Francisco by early December. They are sometimes found in considerable numbers off Washington in December, and from Sitka southward to the Channel Islands of southern California in January. Young males are

Characteristic resting posture of the fur seal at sea.
Photo by Karl W. Kenyon

never as abundant as females of the same year classes in the southern parts of the range. Pups of both sexes arrive off the coast from southeast Alaska to Washington in January; some move southward into California waters. They are found off California in the largest numbers from March through May, but are never as abundant there as off the coasts of Washington, British Columbia, and southeast Alaska.

The northward migration of fur seals from California waters begins in March; however, a few may still be seen there in early June. Fur seals breeding on San Miguel Island probably stay in California waters throughout the year. Migrating seals pass northward through Washington waters from March into June, coming through in waves similar to bird migrations. They may be abundant in one locality for a few days; then only a scattered few are seen until the next wave passes through. The movement of schools of prey species also affects the migration patterns of fur seals, and influences the length of time seals may linger in an area.

Large numbers of seals of both sexes and all ages are found from April through mid-June in the Gulf of Alaska from the Fairweather grounds on the eastern side of the Gulf to the Portlock and Albatross Bank grounds off Kodiak Island on the western side. Some evidence exists that late migrating seals may travel directly across the eastern North Pacific Ocean toward passes of the Aleutian Islands from the vicinity of La Perouse Bank, off the Strait of Juan de Fuca, rather than follow the routes of earlier migrants along the great circle of the coastal shelf north and westward through the Gulf of Alaska. Thus, the annual migratory cycle is completed as the seals once more arrive on the Pribilof Islands.

Fur seals tend to congregate at sea in areas of an abundant food supply. They usually feed at night, probably because most

prey species rise toward the surface after dark and are more readily available. It is believed that most fur seals feed from the surface to a depth of about 50 fathoms, although some are known to have dived to 100 fathoms. When feeding on a school of anchovies to a depth of a few fathoms, the seal may spend only two or three minutes below the surface on each dive. Seals swallow fish or squid about ten inches long or less under water, and bring larger prey to the surface where they break or tear it into smaller chunks by shaking.

About 60 species of fish and squid have been identified from the stomach contents of fur seals taken in the eastern North Pacific Ocean and Bering Sea. Over the years, food species of major importance have been: California — anchovy, hake, several species of squid, and saury; Washington — anchovy, herring, hake, several species of squid, saury, rockfish, and salmon; and Alaska in the North Pacific Ocean and Bering Sea — walleye pollack, capelin, sand lance, herring, several species of squid, and Atka mackerel.

Commercial exploitation of the Pribilof fur seals began with the discovery of their breeding islands in 1786-87, by Gerassim Pribilof. During the period of Russian ownership, 1786-1867, it was estimated that skins in excess of 2.5 million were taken. The population reached a dangerous low between 1806 and 1834. From 1835 to 1867 the harvest of male seals on land was restricted and the taking of females forbidden. The population increased as a result of these measures.

The United States acquired the Pribilof Islands with the purchase of Alaska in 1867. In 1868-69, sealing was unorganized; reports of the number of seals taken during these two years range from 225,901 to 329,000. In 1870, the first of two 20-year leases of sealing privileges was awarded. During 1870-89, 1,854,029 skins were shipped from the islands, and during the second lease period (1890-1909) 342,651 skins were taken. From 1869 to 1911, fur seals were taken with few restrictions throughout their range. Between 1889 and 1909 (the heyday of pelagic sealing) over 600,000 seals were reportedly taken, most of which were females. All fur seal populations declined rapidly during this period. By 1909, only 200,000-300,000 seals remained in the Pribilof Islands population. Years of negotiation, beginning in the 1880s, finally produced the North Pacific Fur Seal Convention of December 1911. The convention prohibited pelagic sealing except by aboriginal people using primitive methods, and arranged

for a sharing of skins taken on land by member countries Great Britain (for Canada), Japan, Russia, and the United States. This convention was in effect until October 1940. The four nations negotiated a new treaty in 1957 entitled "The Interim Convention on Conservation of North Pacific Fur Seals," which is still in force.

Since December 1908, the responsibility for research on and management of fur seals associated with the Pribilof Islands has been assigned to a succession of federal agencies and is currently delegated to the National Marine Fisheries Service (Department of Commerce). The fur seal population is managed for its maximum economic yield by a research and management team of scientists of the Service. Regulation of the take assures that only those seals not needed as replacements for the breeding stock are taken and that the harvest is carried out in the most humane way possible without undue stress. Because the fur seal is polygynous, many more males than females can be and have been harvested.

Whereas males are taken annually, females (although a few are taken accidentally each year) are not harvested except when biological evidence indicates a surplus.

The northern fur seal is quite abundant well offshore in Washington waters from late November to June. They are occasionally sighted in the Strait of Juan de Fuca and a few straggle into Puget Sound almost every year. Beachcombers on the outer coast occasionally find dead fur seals among debris deposited on the beaches by winter storms. In 1959, a female came ashore on the Washington coast and gave birth to a pup, one of the very few times that this behavior has been known to occur on other than an established breeding rookery. During recent excavations at Ozette Village, Cape Alava, Washington, by Washington State University anthropologists, the fur seal was found to be the most important marine mammal taken by the sea mammal hunters of Cape Alava over the last 2000 years (up to 1900). Of the mammal remains found at the site, 80 percent were those of fur seals.

The fur seal can be recognized by its dark color with grayish or white throat and inch-long external ears. When sleeping, it lies on its back with hind flippers folded forward, held in place by a fore flipper. This position was described as a jug handle by old-time sealers. The animal is inquisitive and, when not alarmed, may swim quite close to boats, rearing out of the water to get a better look.

CALIFORNIA SEA LION

Bruce R. Mate

The California sea lion, *Zalophus californianus,* is probably best known for its performances in "trained seal" acts at zoos, circuses, and marine aquariums. However, its external ears and the ability to move on land using all four limbs (flippers), distinguishes this animal as a sea lion (family Otariidae) rather than a seal (family Phocidae). The California sea lion is smaller, darker, and more tropical in its distribution than the Northern (Steller) sea lion, *Eumetopias jubatus.* Male Otariids are generally larger than females: male California sea lions may reach a total length of eight feet and weigh 800 pounds, while females are usually no longer than five feet and not more than 250 pounds in weight. Size has probably been a selective advantage among males establishing and defending breeding territories for millions of years, and has resulted in the sexual dimorphism now apparent in most Otariid species.

Three distinct populations of California sea lions exist and each has been designated as a separate subspecies: *Z. c. japonicus,* from the Sea of Japan may now be extinct; *Z. c. wollebaeki,* on the Galapagos Islands may number from 20,000 to 50,000 individuals; and *Z. c. californianus,* which breeds along the west coast of North America from Mazatlan, Mexico (23 degrees N) north to San Miguel Island, off southern California (34 degrees N) may consist of 50,000 to 100,000 individuals. The latter population is best known.

Pupping and breeding occur on land (usually island rookeries), during May and June. Males usually establish territories on sandy beaches along the water's edge. Females breed with a territorial male shortly after giving birth to a single pup. After the breeding season, many of the adult males move north of the breeding range (some going as far as British Columbia) to spend the winter.

The migration is exceptionally well ordered among those males which participate. Most of the migratory male population moves northward at a uniform speed, and becomes smaller as individuals drop out of the migration to spend the winter at various hauling areas. During this time, many male California sea lions haul out at locations used by the Northern sea lion during the breeding season. At some of these locations the two species intermingle, while other locations may be used exclusively by one species or the other. In mixed groups, it is possible to detect the presence of California sea lions by their distinctive bark, which is different from the lower pitched roar of the Northern sea lion.

California sea lions in captivity usually live 12 to 14 years; one animal was known to live to age 31. This record is unusual, and such longevity may not occur in the wild. Most male sea lions found along the Oregon coast during the fall and winter are between four and ten years old. Animals younger than four apparently do not migrate north as far as Oregon, and adult males over ten comprise only a small segment of the population.

The age of sea lions and many other mammals can be determined using annular layers found in the teeth. Studies of male California sea lion skulls have shown that this species develops a distinctive feature, known as the sagittal crest, starting at about age five. The growth of this portion of the skull is observed in living animals as a "bump" on the top of the head, which becomes increasingly prominent during the animal's adult life. The appearance of this crest is often more striking in older animals because the normally dark hair of the sea lion turns to light brown or tan in this area. Except for the sagittal crest development, the age of California sea lions is often difficult to determine because of the variability in the growth rates of individuals. A four-year-old, for example, may be considerably smaller than some two-year-olds. Sea lions are therefore usually broken into rather crude age class categories in most field studies: pups, yearlings, non-breeders (subadult males and females together), adult females, and adult males. Only fully mature adult males breed. Although subadult males may be sexually mature (capable of successful mating), they do not have the size or strength to hold territories.

Pinniped fossils are scarce, but portions of sea lions closely resembling the Northern sea lion have been found in Miocene formations (11 to 25 million years old) in the Pacific Northwest. Kitchen middens, left by Indians before the white man saw the

Male California sea lions at North Cove of Cape Arago, Coos Bay, Oregon. Photo by author

eastern Pacific, indicate the importance of various marine mammals including the California sea lion to their civilizations. Commercial exploitation of sea lions, particularly along southern California, was instrumental in reducing the populations of many species, and for some species almost caused their extinction.

An enjoyable account of whaling and sealing can be found in *The Marine Mammals of the Northwest Coast of North America* by C. M. Scammon. During Scammon's time, sealing and whaling was an indiscriminate industry unconcerned about the ultimate fate of the resource. However, even Scammon in the late 19th century was aware and reported that certain species had been depleted during his memory. While the California sea lion populations were not reduced to the same extreme as those of the northern elephant seal, *Mirounga angustirostris,* and the Guadalupe fur seal, *Arctocephalus townsendi,* they were taken when more favorable species were not present. It is remarkable that several species of seal and sea lion were not even identified or catalogued as a new species by the time that they were thought to be extinct. Many species were incorrectly referred to, and while some animals had many common and scientific names, other animals had none. This caused considerable confusion. Scammon's book was an authoritative text in its time, but even he

did not discriminate adequately between California and Northern sea lions.

More recent uses of sea lions during this century have included harvesting for dog food and commercial entertainment — zoos, circuses, and aquariums. Today, it is illegal to kill or capture (except by special permit) any species of sea lion in California, Oregon, or Washington.

It is not fully understood how the unmanaged populations of California sea lions have changed since the white man began influencing its numbers. The total numbers of this species were never accurately assessed during the 19th century and have only recently been reported. It is safe to say that the species was reduced in numbers during the 19th century, and has increased over the years to a population which now inhabits its entire range prior to exploitation. The population size is influenced, of course, by the birth rate and death rate. There has been recent concern by a number of marine mammalogists that the annual birth rate (numbers of live births per 1000 sea lions) for both California and Northern sea lions has been decreasing over the last few years.

Without sufficient information about the past performance of these species, it is difficult now to say accurately whether such a phenomena is taking place. High concentrations of chlorinated hydrocarbons (such as DDT) have been found in the tissues of

Male California sea lions at Año Nuevo Island, San Mateo, California.
Photo by Dr. Robert T. Orr

most marine mammals, and have been strongly suspected of causing reduced reproductive success in other species. Reports of high abortion rates and "catastrophic" mortality rates among the newborn pups are still a mystery. Pup mortalities in many species of pinnipeds may be largely the result of weather. A severe storm during the pupping season may be responsible for large numbers of pups drowning or dying from exposure. Sharks and killer whales are natural predators of sea lions, which are often found in their stomachs.

Various parasites have been described from the California sea lion, but unfortunately, not much is known about how these organisms affect their hosts. Diseases among marine mammals are not well known, although rare instances of infection are found in wild animals and illness in captive animals is common. Many problems of captive animals probably arise from diet and increased exposure to exotic microorganisms not encountered in the wild.

During the fall of 1970, the appearance of large numbers of sick California sea lions prompted an investigation by a number of federal, state, and university agencies and departments. The illness was diagnosed as leptospirosis, a disease common to many wild and domestic terrestrial mammals. It can be caused by any one of several species of *Leptospira,* a spirochete bacteria. While this disease typically results in few deaths, a conservative mortality estimate of 10 percent was made in Oregon. The affliction appeared to be limited to males, and reports were more frequent north of the breeding range. This may reflect the distribution of males during this part of the year and/or the more accessable locations of the northern part of the range for observation.

Individual, recognizable males have been observed to return to the same winter hauling area year after year. Consistent numbers of male California sea lions were observed during the fall and winter along the Oregon coast from 1967 through 1970. However, less than 25 percent of those numbers were observed during the fall and winter of 1971, suggesting that the actual mortality among those animals which migrate as far north as Oregon may have been as great as 75 percent. This apparent high mortality may reflect the typical reaction of many species upon exposure to a new disease. It is not known at the present whether California sea lions have ever experienced leptospirosis before. Therefore, it is difficult to conclude whether this or

Male California sea lion on the breakwater at Monterey, California.
Photo by author

other natural diseases may be the effective regulators of their population numbers. Since one male can mate with many females, the reproductive potential of the population is not affected when only some males are ill. An illness during the fall of 1947 resulted in many beach-cast and dead sea lions in California; the tentative diagnosis was streptococcal pneumonia. But it may have been leptospirosis.

The incidence of leptospirosis during 1970 was the first epizootic ever observed under natural circumstances in any marine mammal. This disease is spread via the urine allowing an infected animal to expose large numbers of healthy sea lions to the organism around the hauling grounds. Northern sea lions have a very similar anatomy and physiology to that of the California sea lion. Although these two species cohabitated many hauling areas during the fall and winter of 1970, the Northern sea lions failed to show any symptoms of leptospirosis. An explanation of this phenomena may be that the environment of the winter hauling areas is too harsh for the bacteria to survive and hence, can not spread to other individuals. Or, the bacteria may be species-specific and unable to infect the Northern sea lion even under optimal conditions. The California sea lions may have been exposed to *Leptospira* bacteria during their breeding season in the more temperate surroundings (than their winter hauling areas) of southern California and Mexico. The recent introduction of goats, which are known to contract leptospirosis, to several of the California Channel Islands may have been the source of initial exposure to the California sea lions breeding there. It remains to be seen whether this illness will persist, and cause any major changes in population structure or seasonal movements.

STELLER SEA LION

Roger L. Gentry

The chilly waters of the North Pacific Ocean are the province of the Steller sea lion, largest of the eared seals. Remote and windswept islands from northern Japan to central California are the focal points to which widely scattered adults are drawn each summer. They are the dispersion points for thousands of young sea lions born into the complex, but temporary, societies formed there. This annual pattern has repeated since at least 1792 when Georg Wilhelm Steller, German naturalist, first described it; its roots extend back to the first appearance of these animals in the fossil record, several million years ago.

The on-land phase of the yearly cycle is best known to scien-

tists because many animals gather predictably at certain sites, and are easily approached. Even though this phase is short, lasting less than three months, it is of great significance because all the reproductive functions take place on land. By contrast, Steller sea lions, like the northern fur seal and other Otariids (eared seals), are almost impossible to observe while at sea.

When visiting a breeding island, or rookery, for the first time several facts are immediately obvious. The males are perhaps three times larger than the females, each weighing about a ton, whereas the females may outnumber the males by as many as ten to one. It also becomes apparent that males are quite immobile, each remaining within an area of about 200 square meters, and evenly spaced. Females, on the other hand, may lie next to one another in dense clusters, or wander freely across the rookery.

The difference in size, numbers, and spacing between males and females is due to the behavior of males, whose threatening encounters are conspicuous on the rookery. These animals attach themselves to a piece of terrain, stay within definable boundaries, and threaten any male that approaches. During threats, both opponents hurl themselves on their bellies, face to face, only inches apart. They hiss and puff at each other, ending with a bout of rapid neck fencing and sometimes biting. A fight follows if either opponent passes beyond the boundaries of these

Territorial fight involving three males — the one on the right is covered with blood.
Photo by author

mutual displays. Because of these threat displays, males space themselves evenly, and the spacing determines the number of males on a restricted rookery. Success in territorial fights probably accounts for the large size of the males.

Because males hold repeated threat displays, the display locations can be used to define each male's territorial borders. Most boundaries follow natural lines, such as faults or ridges in the rock, which give an uneven shape to each territory. The greater the separation, the more stable the boundary. Males whose territories are well delineated geographically may successfully breed in the same location for four seasons with no change in boundaries.

Males not only remain geographically fixed at a rookery, but they rarely if ever leave during the breeding season. Thus they may not feed for up to 60 days, their only water coming from body stores or filthy tidepools. During this period they may hold more than 400 threat displays, have a dozen fights, copulate with up to 30 females, and chase away many juvenile males. The reproductive season seems to impose almost unparalleled physiological stresses on male eared seals. Small wonder that few, if any, withstand these rigors for more than four years of life!

Although the females do not defend territories as the males do, their behavior too is divided into yearly phases. Most females arrive at the rookery only a few days before delivering a single pup. Within two weeks they mate with a territorial male, usually only once, and then settle into a routine of feeding trips at sea and returning to feed their young. Most females leave the rookery about nine months after giving birth, and migrate to unknown locations. Perhaps during this absence, females wean their young because most return alone to the rookery the next season. The Steller sea lion yearly cycle may last up to 20 years, and it is possible, although improbable, that a pup could be produced each year.

Males and females show dissimilar social behavior. In all studies on this species, no lasting social organization, such as a dominance or leadership hierarchy, has been found among the females. Instead, they form loose assemblages in which the memberships are continually changing, and except for an occasional threat or not-so-gentle nip, there is little aggression among them.

During the reproductive season, the behavior of females toward each other changes markedly. Starting a day or two before giving birth, some females become aggressive and may force

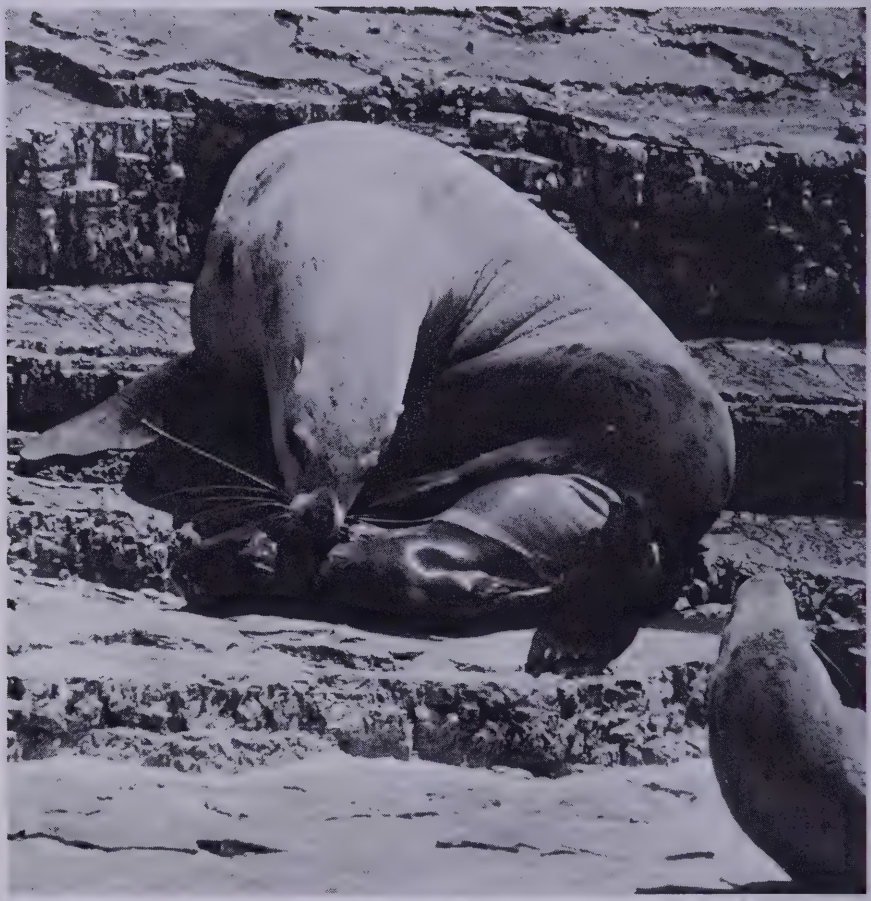
others away from them. Occasional fights erupt between two such females so that spacing increases among all individuals. But this effect is only temporary and never reaches the proportions of the male territorial system. This increase in spacing is short-lived; females again tolerate each other only a few days after giving birth.

A superficial glance at a rookery sometimes reveals clusters of females associated with a male, with open spaces between adjacent clusters. In the past this arrangement has been interpreted as semi-permanent "harems" over which the males are masters; the evolutionary consequences of this situation have been discussed by many authors. We now know through prolonged observation that these groupings do not last, and there are no bonds between males and females. The females naturally tend to group together; the spaces between clusters usually form when females avoid the territorial boundaries with their threat displays. Although males try to herd females away from territorial boundaries, they are usually unsuccessful and females cross them easily.

Females show no lasting attachments to specific males, or to selected territories. A female may give birth in one territory, copulate in another, and reside in several others with her pup before the season ends. If a female leaves a territory and returns to it repeatedly, it is usually to rejoin a pup left there. Therefore what has been termed a harem structure among eared seals is really a collection of animals using the same area, with males unsuccessfully blocking the movements of normally gregarious females.

The silver-black pups, born in June and July, are quite precocial. They can walk and suckle within half an hour of birth, and if forced, can swim weakly within a few hours. During the first two weeks of life pups remain with their mothers, suckling often, and avoiding other pups and females. After two weeks, when the mother has copulated and has resumed her feeding trips to sea, pups voluntarily enter the water for the first time and begin to interact with other pups. As the mother's feeding trips become longer, pups spend more time chasing and mock-fighting with their fellows. If a pup's mother dies, the pup dies too because there is no fostering of young among Steller sea lions. In fact, females may bite and toss any pup but their own.

In California, only about two percent of the pups go on suckling after their first year. But in Alaska as many as 80 percent



A female at the moment of birth. *Photo by author*

of the pups may remain unweaned into their second year. The reasons for these differences and their consequences on the reproductive rate are unknown.

Weaned sea lions, including pups of the previous year, have a different yearly cycle than the adults. Most animals one and two years old do not return to the rookery. However, when males are about three years old they return to the island and gather on separate non-breeding or "bachelor" areas. There they spend many hours together chasing and mock-fighting or making occasional forays into the breeding areas where they are chased by resident males. They do this every year until they are large enough to compete for a territory among the females. Young females, on the other hand, may return to the rookery to breed in their third year, and return every year thereafter to bear

Adult male and female copulating. *Photo by author*

a pup or copulate.

When the breeding aggregation breaks down in August, males leave the rookery immediately, and females follow within a few months. In California, a general northward migration leaves few Steller sea lions there in the winter. In Alaska, a general southward migration brings animals into warmer water at winter's approach. To date we do not know the length, duration, or path of migration for individual sea lions. We know some of the islands they use in the winter, but not their pattern of going to sea and returning.

An important event for the females, and for the whole species, occurs about three months after the breeding season ends. At that time the fertilized egg carried by the female attaches to the uterus wall and begins active growth. The cause of this "delayed

Adult male and young pup. Photo by author

implantation" is not known, but its effect is clear: it sets the date when all pups will be born in the next year, and thus determines when males and females should gather at the rookeries.

Although the sea lion's hunting methods are unknown, examination of stomach contents and watching daily movement patterns suggest that they feed mostly at night. Most feeding occurs in less than 100 fathoms of water, usually not more than 15 miles from shore.

Both males and females appear to be opportunistic feeders, consuming flatfish, rockfish, or whatever they can. In all studies to date, no commercially valuable fish, such as salmon, has been found as a major dietary item. The dependence of sea lions on these stocks may have been exaggerated because sea lions are rarely seen feeding except when they occasionally molest fishing gear. The coexistence of sea lions and what are now considered commercially valuable fish has obviously lasted millions of years.

With the coming of spring Steller sea lions approach a new reproductive season, and are drawn from their winter haunts towards their respective breeding areas. There, with a timing perfected through the ages, the social system entities emerge, mesh, and conceive the new lives for species survival.

HARBOR SEAL

Terrell C. Newby

The names, harbor seal, spotted seal, common seal, and hair seal, apply to a shy and retiring animal seldom or never seen by the average citizen of the Northwest . . . *Phoca vitulina.* This seal belongs to the family Phocidae, the true or earless seals. Two subspecies are found along the eastern Pacific, *Phoca vitulina largha, P. v. richardi. Largha* is distributed from East Cape in the Bering Sea (170 degrees W) to the coast of China, and *richardi,* from Herschel Island in the Bering Sea (69 degrees 35' N, 139 degrees W), south to Cedros Island off Baja California, Mexico.

In 1958, the estimated world population was 20,000 to 50,000 and 50,000 to 200,000 respectively for *P. v. largha,* and *P. v. richardi.* Note that these figures are out of date, and in some areas the populations have been considerably reduced. An example is in Washington State where the harbor seal, once a valuable fur bearer and source of native food, was hunted till its numbers dropped from over 10,000 in the 1920s to just slightly over 2100 today.

Throughout northwest waters, the seal frequents rivers and marine estuaries. Along the Washington Coast and in Puget Sound, one might find it hauled out during low tide on sand bars and coastal rocks. Around the San Juan Islands, it tends to prefer small reef rocks for low tide haulings and ventures. Seeming to prefer a particular spot for its hauls, the harbor seal usually spends equal amounts of time on land and sea. Still, the hauling ground is its home — the hub of its life activities.

The harbor seal, is characterized by its lack of external ears, fusiform body and inability to rotate its hind limbs forward. A typical seal might weigh up to 250 pounds and reach a length of five or six feet. Coloration varies from near white to black but

most often is bluish gray with black spots and irregular white rings and loops.

Seals are specially adapted for diving and apparently can dive to depths in excess of 300 feet. They average nine knots while swimming and upon pursuit might increase to 15 knots.

The diving seal employs an interesting mechanism to conserve oxygen. By vasoconstricting all peripheral blood vessels, it limits its blood supply to only the vital organs — heart, lungs, kidneys, brain, and intestines. During a dive, its heart slows from an average 85 beats per minute to 15 or 20 beats. While most dives average five to six minutes, some can last up to 20 minutes. Due to high myoglobin (oxygen carriers in the blood) levels in seal muscle, it does not suffer tetany or muscle oxygen deficiency during these dives.

The Washington State harbor seal is unique among the species because of its three distinct pupping seasons. Statewide pupping begins in May on the outer coast, followed by a northern Puget Sound season in July and finally, in August, the season begins in southern Puget Sound. Sexual maturity occurs between three to five years, and a single pup is born to each female. The mother of a newborn pup does not consume the afterbirth, leaving it instead to the sea gulls who devour all but the fetal blood vessels. (The harbor seal placenta weighs two and one-half to three

Adult harbor seals.
Photo by author

pounds.)

Harbor seal pups, unlike many other Pinnipedia, can swim moments after birth. The newborn pup has already completed one full molt while still in the womb. Its shed hair resembles that of the snowy white arctic species, suggesting some as yet undiscovered adaptation to our southern climes where such "protective coloration" would render the young especially susceptible to predators such as wolves, foxes, bears, and man.

At birth the average male pup weighs 30 pounds and is 30 inches long, while the newborn female weighs approximately 20 pounds and is 25 inches long. For four to six weeks the young nurse, and by the third week have actually doubled their birth weight. A 42 percent butterfat content in the mother harbor seal's milk stimulates such rapid growth. (Human maternal milk contains three to six percent butterfat.)

During the nursing period, the pup actively plays with its mother, riding on her back, nipping at her flippers, and chasing her in the water. The female harbor seal is a very devoted parent and though she may temporarily abandon her young if disturbed, she will soon return to retrieve it. At birth the harbor seal pup is a very skinny and pathetic looking creature, easily mistaken for an orphan by the compassionate beachcomber. Unfortunately, many youngsters have been whisked away from their mothers

by well meaning but untrained persons. These young animals invariably end up in our zoos and aquariums. In my six years of study of these animals, I have only observed three true orphans, two of which are now in aquariums and the other happily living out her life in the wild.

Soon after weaning, the adult female is ready to breed again. The harbor seal is gregarious and polygynous but lacks the harem structure common to many other pinnipeds. Just prior to copulation, there is a great deal of excited pre-coital play, during which the female takes fierce bites of the male's neck and shoulders while the two animals roll, cavort, and occasionally jump completely out of the water. During the breeding season, one commonly observes numerous five to seven-year-old males bearing the wounds of love play. Copulation usually takes place in the water.

After conception, delayed implantation retards embryonic development. This characteristic of many marine mammals, and even of some bears, is not well understood. Simply stated, the fertilized egg (zygote) remains in the blastula (ball) stage of development for a period of one and a half to two months, then implants in the uterine wall and begins full development. Actual fetal growth requires between nine and ten months, so that total time from conception to birth is about 11 months.

The life expectancy of the harbor seal is estimated at 29 years, although there are few known ages recorded. In my studies, I have determined age in animals that have lived naturally beyond 20 years. Of the harbor seals in captivity, "Dub Dub" at the Tacoma Aquarium was a record 33 years old at the time of his recent death. Seal teeth facilitate age determination since they grow throughout life by adding layers of dentine and cementum. A large canine tooth cut in thin cross-section displays layers in concentric rings, similar to growth rings in a tree. As is the case with the tree, each clearly defined ring represents one year of the seal's life. Such an aging process appears easy but is not recommended for those with weak eyes!

The chief reason for the harbor seal's conflict with man has been its taste for an occasional salmon, yet salmon accounts for a mere two percent of its dietary needs. Foods preferred by the harbor seal are sole, flounder, sculpin, hake, herring, and sometimes an odd clam or snail. But because of the damage it can do to fishing nets and the relatively small percentage of salmon consumed, the harbor seal has literally come "under the gun."

Approximately 17,000 seals were killed for bounty between 1940 and 1960. The extensive hunting pressure of the past has caused the timid seal to abandon such traditional hauling grounds as Washington's Nisqually Delta, where in the 1940s it numbered nearly 200. Along with the cormorant and the sea lion, the seal continues to be classified as a predator, even though today there are no funds available to pay a bounty.

It is entirely possible that the harbor seal population may recover to such a degree that it will have to be managed and controlled, but that day is still many years away. Today the mature seal's only worries come from man and an occasional killer whale, its natural predator.

The harbor seal's economic importance is minimal. In Washington, it is commercially extinct, the only past value resulting from three dollars to eight dollars bounty payments. In Alaska and British Columbia, the value of raw or untanned harbor seal skins rose in 1963 from about five dollars to over 25 dollars per skin because of the depleted supply of North Atlantic seal skins for European markets. This fur "gold rush" only affected the Alaskan and British Columbian markets where the seals were numerous enough to be worth harvesting. Since the boom of 1963-64, the price in Alaska has once again dropped back to about 12 dollars per pelt at international auction. British Columbia has since imposed protective legislation for all marine mammals.

The true value of harbor seals and other marine mammals of Washington State is esthetic and scientific. Captain Scammon wrote in 1874: "At times, when a number meet in the neighborhood of rocks or reefs distant from the main land, they become quite playful, and exhibit much life in their gambols, leaping out of the water or circling around upon the surface." This is the true beauty of *Phoca vitulina.*

ELEPHANT SEAL

Terrell C. Newby

Perhaps the homeliest of the pinnipeds, the northern elephant seal, *Mirounga angustirostris,* is also the largest of the North Pacific seals. Weighing up to three tons, males reach lengths of 18 — 20 feet. Females are much smaller, weighing about one ton and measuring 10 — 12 feet. The male's protruding, bulbous snout characterizes the elephant seal. In old breeding males this snout, when relaxed, hangs down over the mouth, drooping to 12 inches long.

These large mammals range along the eastern Pacific from Baja California, Mexico, north to Kasaan Bay, Prince of Wales Island, Alaska. Rarely they may be sighted as far as 2800 miles north of their northern-most breeding area, Ano Nuevo Island, California. They are infrequent visitors to Washington, however, and when seen are easily mistaken for large "deadheads."

Two male elephant seals at San Miguel Island, California. Photo by author

Elephant seal pup — about six months old. *Photo by author*

Although these animals are known to consume ratfish, squid, small sharks, skates, and other fishes, elephant seal food habits are poorly documented. Deep water feeding is likely, since ratfish are unusual above 50 fathoms.

The breeding season for these seals extends from December to March, peaking in January and February. Males of this group, unlike other Phocids (earless seals), gather distinct harems of about a dozen females. Harem and territory are viciously defended by the harem bull.

Pups are born with wavy gray-black fur which is shed about two weeks after birth. Newborns cannot swim and do not enter the water until nearly two months after parturition.

While sharks and killer whales have always been *Mirounga's* natural enemies, commercial exploitation for elephant seal blubber began about 1818. An average 12 foot bull yielded about 90 gallons of oil. By 1860 the seals were commercially extinct, and between 1865 and 1880 only occasional stragglers were found. One single herd of 100 animals or less remained by 1890. Located on Guadalupe Island, Mexico, these seals were granted absolute protection by the Mexican government in 1922.

That once small herd now numbers over 20,000 animals comprising several colonies, and has recovered sufficiently to be removed from the list of endangered marine mammals.

PACIFIC WALRUS

Karl W. Kenyon

Among seal-like marine mammals, unique characteristics dramatize the walrus — its skin, tusks, digestive system, and its method of sleeping at sea.

The walrus (family Odobenidae) shares certain characteristics of both eared seals (Otariidae) and earless seals (Phocidae). Superficially it is like the phocids in that it lacks an external ear; but it shares basic structural characters with otarids, such as the ability to rotate the hind flipper forward and walk on a solid surface. In size, the walrus is second to the elephant seal — a large male weighed 3432 pounds and a female 1500 pounds. Newborn calves may weigh up to 150 pounds.

The hairy coat is short and light rusty brown. While molting, the "warty" skin of the male becomes hairless. It is whitish in cold water, but when the animal rests in warm sunlight, blood circulation increases and it becomes quite pink. Examination of dentine layers on teeth has shown that life expectancy is 20-30 years.

Paired air sacs in the neck of the walrus, unknown in other pinnipeds, may be inflated, holding the sleeping animal's head above the surface of the sea.

Also unique among marine mammals is the walrus's heavy canine teeth — tusks — which in the male may reach 39.5 inches long and weigh 12 pounds. Those of the female are slimmer and lighter. Characteristically, the walrus is associated with ice packs where it hauls out, aided by its tusks, to sleep and bear young. Large groups of males gather in late spring and summer on terrestrial hauling-out grounds, where they molt.

Eskimo hunters often eat undamaged clam meat from a slaughtered walrus, after rinsing it in sea water. Stomach contents consist predominantly of clam meat, without shells. The unique structure of the walrus's mouth and tongue produces suction,

like a vacuum cleaner — apparently meat and shells are separated and the shells discarded. Chewing is improbable. The walrus gathers its food from the bottom, usually at depths of 120-200 feet.

Male walruses may reach sexual maturity at the age of six years, females at five to seven years old. Among pinnipeds, the mother walrus cares for her calf for an unusually long period. The calf suckles for nearly two years, and often rides on its mother's back as she travels north in the spring. Usually only one calf is produced, though several twin fetuses are recorded. The mother may become pregnant again when her calf is one or two years old. Most young are born in April and May after a gestation period of about one year. According to Eskimo legend foster mothers adopt orphan calves, but it seems improbable that a female would nurse a calf other than her own. Other pinnipeds are known not to tolerate orphans. Much of their social behavior, such as harem formation and territoriality, is obscure.

The economic incentive to exploit pinnipeds for oil and hides decreased after the chaotic slaughter of the 18th and 19th centuries when many species were seriously depleted. During the present century those which continue to yield valuable products — such as elephant seals *(Mirounga)* and fur seals *(Callorhinus* and *Arctocephalus)* — are protected. The Pacific walrus occupies a unique position — demand for its ivory, both carved and unworked, or raw, has increased in recent years.

In May 1958, when the late Stan Fredericksen and I arrived to begin a walrus study at Ignalook Village, Little Diomede, the island was icebound. Hunting started a week later and was almost finished when I departed in mid June; virtually all ice had passed northward into the Chukchi Sea.

Until June the ice shelf between Little and Big Diomede remained intact and hunting was conducted from the south tip of the island. To reach this the hunters, assisted by dog teams, hauled their boats a mile over the ice. When the possibility of open water existed, the hunters often slept on shelves of the granite cliffs, or in the boats hauled up on shore ice. A lookout with binoculars kept a constant watch for open leads and for walruses.

During the study period roughly 5000-10,000 walruses passed Little Diomede through the eastern Bering Strait — 1900-2100 were actually seen. The majority usually pass northward through waters off Siberia, west of Big Diomede. Fog often reduced visibility, but walruses were heard bawling.

Adult male walruses, Round Island, Bristol Bay, Alaska — one with a missing tusk.

Photo by author

While the ice was breaking up and passing through Bering Strait, the Eskimos hunted from their umiaks throughout the 24 daylight hours. From the hundred Eskimos at Ignalook there were enough hunters to man four boats — wooden framed, from 20-30 feet long, covered with walrus skins, and powered by 15, 20, and 30 horsepower outboard engines. Each carried six to 13 hunters (usually six to eight) and went four to ten miles out to sea — sometimes 30 miles. While we were there the Eskimos made 57 hunting trips — 245 walruses were killed that season of which 117 were recovered and 128 were lost through sinking.

Biological studies of walruses were made during the past decade, primarily by John J. Burns of the Alaska Department of Game. His studies indicate the population is increasing. Biologists of the Alaska Department of Game and the U.S. Bureau of Sport Fisheries and Wildlife conducted five aerial surveys of walruses between 1960 and 1972. These indicate that when the Bering Sea ice pack is at its maximum, walruses are concentrated primarily in two areas: in the western Bering Sea both north and south of St. Lawrence Island, and in central Bristol Bay. They are scarce in the northeastern Bering Sea. It is impossible to count all walruses because the areas in which they occur consist of many thousands of square miles of ice. In 1972 we counted over 9000 walruses along a one mile wide flight track during a flight covering about 5000 miles. From our data we calculated the population of Pacific walruses probably numbers more than 100,000 animals.

Since prehistoric times Eskimos of certain Bering Sea islands — namely Nunivak, St. Lawrence, King, and Big and Little Diomede — have depended on the walrus. Meat and blubber are used for human and sled dog food; blubber oil may be used for fuel in lamps; skin is cut in strips for line and rope, and split into two sheets to cover their wood frame boats or umiaks; and tusks traditionally made a smooth surface for sled runners, but in modern times their primary use is for carving of small figures including walruses, polar bears, seals, other wildlife, and Eskimos. These are so popular with the tourist that many walruses were killed primarily for their tusks — a practice called "head hunting."

To reduce this wasteful killing, Alaska State law prohibits the sale of raw (uncarved) ivory. In addition, limits are placed on the number that individuals may kill — trophy hunters are limited to one adult male and only subsistence hunters may kill more.

A number of factors favoring walrus conservation developed

Male walruses, Round Island, Bristol Bay, Alaska. Note the warty skin and sparse hair of this molting group. *Photo by author*

during the past decade. One is the large scale use of snow machines which has greatly reduced the use of dog sleds — large quantities of meat for dog food are no longer needed. Ironically, trophy hunting, authorized in May 1957, is one of the most important conservation factors. In 1969 John J. Burns wrote that the Eskimos "have reached the point of a rapidly developing trend toward providing services for trophy hunters and photographers that is resulting in reduced harvests and increased monetary return to Eskimo guides . . . . .

"Resident subsistence hunters are very interested in becoming guides since they no longer have to secure the large quantities of meat formerly required. Numerous regulations apply to guides and one of the most important is that guides (and the entire boat crew working for a guide) are not permitted to take game while guiding . . . . Each guided hunt (for a trophy or for photos) in essence eliminates one of the traditional boat hunting days in which many walruses were killed. Instead, one bull is taken (or none if a photographer is out), the meat goes to the crew, they also receive a very worthwhile fee, and the hunter gets his trophy."

In recent years island Eskimos moved to mainland towns — another conservation factor. King Island, where a large part of

Male walruses, Round Island, Bristol Bay, Alaska, hauled out on rocks to molt. One has a tusk broken in half. *Photo by author*

the total Alaska kill of 1500-2000 walruses was taken, is completely deserted today. Few hunters return from their new homes in Nome to take part in the traditional spring hunt.

The only regular summer hauling grounds for walrus still in existence on United States territory are at the Walrus Islands in northeast Bristol Bay, Alaska. In June 1958, we found walruses — 1500-2000 males, both adult and immature — on only one of this group of seven islands — Round Island. Most of them were hauled up on narrow cobble beaches skirting the base of sheer granite cliffs, more than 100 feet high. The majority were molting; many were completely hairless. They were not easily alarmed when approached quietly upwind, and we were able to place metal tags on the flippers of 12 resting individuals.

As a result of our survey we concluded that the Walrus Islands in Bristol Bay should be set aside as a walrus refuge. Our opinion was strengthened when some Togiak villagers were convicted of wastefully slaughtering walruses at the Round Island hauling ground. In June 1960, the Alaska government designated these islands the "Walrus Islands State Game Sanctuary," but the natives of Togiak petitoned for special hunting privileges there.

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CONTRIBUTORS

CLIFFORD H. FISCUS is a wildlife research biologist with the National Marine Fisheries Service, Northwest Fisheries Center, Marine Mammal Division. He has been with the Marine Mammal Division (formerly Marine Mammal Biological Laboratory) since 1958, primarily involved in ocean research on fur seals.

ROGER L. GENTRY received his Ph.D. from the University of California (Santa Cruz) in 1970. He is now assistant research biologist in the Marine Study Center of the same campus, has published articles on the sea otter, California sea lion, Steller sea lion, South Australian fur seal, and Guadalupe fur seal, and has recently done research on the Adelie penguin.

KARL W. KENYON is a wildlife research biologist with the U.S. Fish and Wildlife Service. He received his M.S. degree in ornithology from Cornell University, and has specialized in marine wildlife, particularly the Alaska fur seal, Laysan and black-footed albatrosses, the Steller sea lion, Hawaiian monk seal, and Pacific walrus. Assigned to sea otter research since 1955, he has published widely in zoological journals.

BRUCE R. MATE received his B.S. in biology with an emphasis on marine invertebrates and ecology from the University of Oregon. He began his studies on the California and Steller sea lions in 1968 at the University of Oregon's marine station, the Oregon Institute of Marine Biology, received his Ph.D. in 1972, and is currently continuing his work on problems regarding marine mammals at Oregon State University.

TERRELL C. NEWBY is specializing in the ecology and natural history of the Pacific harbor seal and killer whale in a Ph.D. program at the College of Fisheries, University of Washington. He worked as a research biologist for the U. S. National Marine Fisheries Service in 1971, has published several papers, and is currently involved in the U. S. International Biological Program's Marine Mammal studies, sponsored by the Smithsonian Institution.

MAXINE MORSE graduated in fine arts from the University of Washington, did graduate work in art, studied further under

She has been

the University

d book editor

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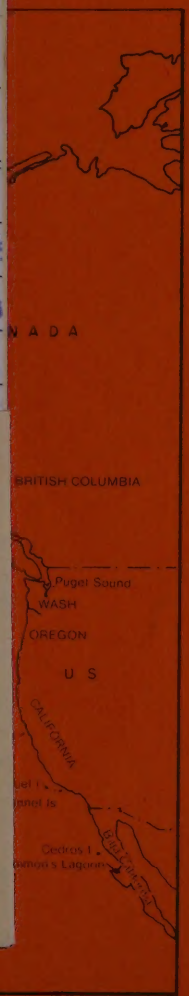

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